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(71)(72) Applicant and Inventor: WILK, Peter, J. [US/US]; 185 West End Avenue, New York, NY 10023 (US).

(74) Agent: SUDOL, R., Neil; Coleman & Sudol, 261 Madison Avenue, New York, NY 10016-2303 (US).

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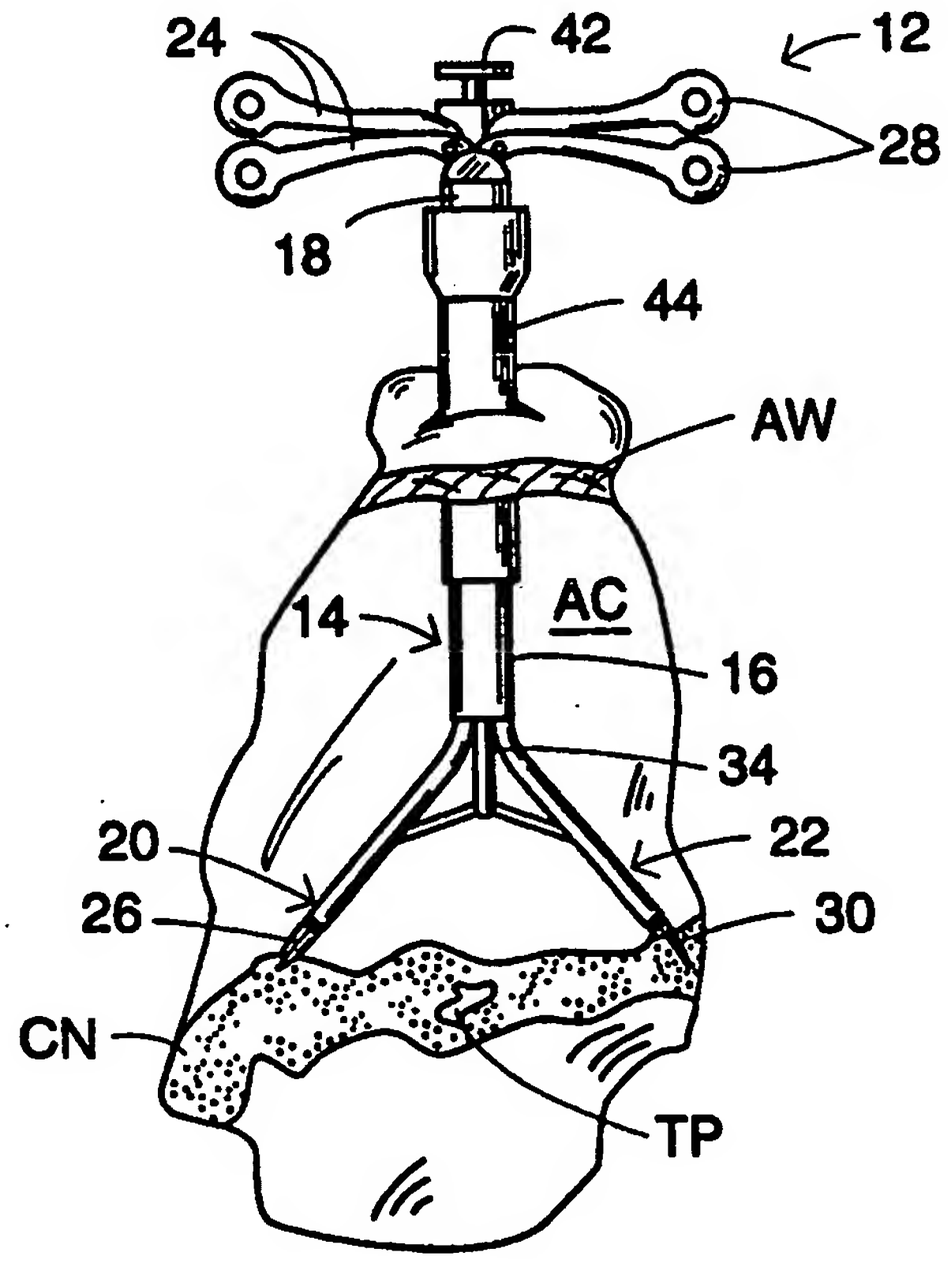
(54) Title: SURGICAL SPREADER ASSEMBLY AND ASSOCIATED METHOD

(57) Abstract

A surgical device including a frame member (14) having a distal end and a proximal end and a pair of clamping mechanisms (20, 22) movably mounted to the frame member at the distal end thereof for exerting clamping forces on spaced tissues of a patient. Actuators (24, 28) mounted to the frame at the proximal end thereof are operatively connected to the clamping mechanisms for controlling the operation thereof. Another actuator (32), also mounted to the frame member, is operatively connected to the clamping mechanisms for increasing a distance therebetween, thereby stretching tissues between the clamped tissues. The instrument assembly is particularly useful during laparoscopic surgery.



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SURGICAL SPREADER ASSEMBLY AND ASSOCIATED METHOD

Background of the Invention

This invention relates to a surgical instrument assembly. More particularly, this invention relates to a spreading device for use in surgery. This invention also relates to an associated surgical method or procedure.

During surgical operations, one of the most important operations is the spreading of convoluted and folded organic tissues to enable visual inspection and physical access to a potential surgical site. Generally, such access is achieved by initially attaching a first clamp to tissues on one side of the desired site and a second clamp to tissues on the opposite side of the site. The clamps are then pulled apart, by surgical assistants, to spread the tissues between the two clamps.

Such a procedure, although useful and effective in open surgery, could be streamlined. In addition, the procedure is cumbersome if used in laparoscopic surgery.

Laparoscopy involves the piercing of a patient's abdominal wall and the insertion of a cannula through the perforation. Generally, the cannula is a trocar sleeve which surrounds a trocar during an abdomen piercing operation. Upon the formation of the abdominal perforation, the trocar is withdrawn while the sleeve remains traversing the abdominal wall. A laparoscopic instrument, such as a laparoscope or a forceps, is inserted through the cannula so that a distal end of the instrument projects into the abdominal cavity.

Generally, in a laparoscopic surgical procedure, three or four perforations are formed in the abdomen to enable deployment of a sufficient number of laparoscopic instruments to perform the particular surgery being undertaken. Each perforation is formed by a trocar which is surrounded by a sleeve, the sleeves or cannulas all remaining in the abdominal wall during the surgical procedure.

Prior to insertion of the first trocar and its sleeve, a hollow needle is inserted through the abdominal wall to enable pressurization of the abdominal cavity with carbon dioxide. This insufflation procedure distends the abdominal wall, thereby producing a safety space above the patient's abdominal organs.

Laparoscopic surgery provides several advantages over conventional incision-based surgery. The laparoscopic

perforations, in being substantially smaller than the incisions made during conventional operations, are less traumatic to the patient and provide for an accelerated recovery and convalescence. Hospital stays are minimized. Concomitantly, laparoscopic surgery is less time consuming and less expensive than conventional surgery for correcting the same problems.

To enable access to a desired surgical site during a laparoscopic operation, the tissue spreading procedure described above requires the formation of at least four abdominal perforations and the insertion of four trocar sleeves. Two sleeves are required for the clamps, another sleeve for the laparoscope and a fourth sleeve for an instrument (e.g., scalpel, forceps, cautery probe, etc.) to perform a surgical operation at the sugical site which has been made visible by the tissue spreading procedure. The provision of so many abdominal perforations with their respective trocar sleeves is problematical because of the evident goal of minimizing the number of perforations.

Summary of the Invention

A laparoscopic surgical device comprises, in accordance with the present invention, an elongate frame member having a distal end and a proximal end and tissue stretching componentry mounted to the frame member at the distal end thereof for engaging and stretching selected internal organic tissues of a patient during a laparoscopic procedure. An actuator is mounted to the frame member at the proximal end and is operatively connected to the stretching componentry for operating the stretching componentry to spread the selected internal organic tissues of the patient to faciltate a surgical operation on the selected internal organic tissues.

According to another feature of the present invention, the stretching componentry includes a first engagement element movably mounted to the frame member at the distal end thereof for engaging first organic tissues of the patient, and a second engagement element also movably mounted to the frame member at the distal end thereof for engaging second organic tissues of the patient spaced from the first organic tissues. The first organic tissues and the second organic tissues are portions of the selected internal organic tissues. The surgi-

cal device further comprises a spreading control mounted to the frame member and operatively connected to the first engagement element and the second engagement element for increasing a distance between the engagement elements upon engagement of the first and the second organic tissues by the respective engagement elements.

According to a further feature of the present invention, the first engagement element includes a first clamp for exerting a clamping force on the first organic tissues, while the second engagement element includes a second clamp for exerting a clamping force on the second organic tissues. The actuator includes a first control element and a second control element operatively connected to the first clamp and the second clamp, respectively, for controlling operation thereof. At least one of the clamps may include a pair of jaws.

According to an additional feature of the present invention, the engagement elements are secured to the frame member via respective shafts, while the spreading control includes an articulated linkage pivotably connected to the shafts. The spreading control further includes means for alternately shifting the linkage in a distal direction and a proximal direction.

A surgical method in accordance with the present invention utilizes a surgical instrument with an elongate frame having stretching componentry at a distal end for engaging and stretching organic tissues and having an actuator at a proximal end for operating the stretching componentry. The method comprises the steps of (a) inserting a distal end portion of the instrument through a laparoscopic trocar sleeve into a patient, (b) engaging selected organic tissues about an operative site with the stretching componentry upon insertion of the distal end portion of the instrument through the trocar sleeve, (c) operating the actuator to stretch the organic tissues upon engagement of the selected organic tissues with the stretching componentry, and (d) performing an operation at the surgical site upon stretching of the selected organic tissues.

Where the stretching componentry includes first and second engagement elements for holding organic tissues, the step of engaging the selected organic tissues includes the

step of holding the selected organic tissues with the first and second engagement elements and exerting a force via the surgical instrument to increase a distance between the first and second engagement elements.

In accordance with another feature of the present invention, the step of holding may include the step of clamping the selected organic tissues with the first and second engagement elements.

In accordance with yet another feature of the present invention, where the stretching componentry includes a plurality of clamping mechanisms disposed at distal ends of respective flexible shafts connected to the frame, the step of engaging selected organic tissues includes the step of operating the clamping mechanisms to clamp organic tissues of the patient at spaced points with the clamping mechanisms, and the step of operating the actuator includes the step of pressing the shafts apart from one another.

A surgical instrument assembly and associated method in accordance with the present invention for use in spreading organic tissues of a patient during an operation are particularly useful in laparoscopic surgery. Only one trocar sleeve is required. However, the method and instrument assembly may be used in open surgery as well.

Brief Description of the Drawing

Fig. 1 is a schematic side elevational view of a laparoscopic surgical clamping assembly in accordance with the present invention, showing a pair of grasping forceps disposed in a mutually parallel insertion configuration and with closed grasping jaws.

Fig. 2 is a schematic side elevational view of the laparoscopic surgical clamping assembly of Fig. 1, showing the grasping forceps disposed in a spread-apart use configuration and with opened grasping jaws.

Figs. 3A-3C are partial schematic cross-sectional views of a patient's abdomen with the surgical clamping assembly of Figs. 1 and 2 inserted therein, the clamping assembly being illustrated in successive steps of a clamping and spreading operation in accordance with the present invention.

Fig. 4 is a partial schematic side elevational view of another laparoscopic surgical clamping assembly in accordance with the present invention, showing a pair of grasping forceps disposed in a mutually parallel insertion configuration and with closed grasping jaws.

Fig. 5 is a partial schematic side elevational view of yet another laparoscopic surgical clamping assembly in accordance with the present invention, showing two grasping forceps parallel to one another insertion configuration and with closed grasping jaws.

Detailed Description

As illustrated in Figs. 1 and 2, a surgical clamping device 12 for spreading or stretching clamped organic tissues comprises a frame member 14 having a distal end 16 and a proximal end 18. Two clamping mechanisms in the form of respective grasping forceps 20 and 22 are movably mounted to frame member 14 at distal end 16 thereof for exerting clamping forces on spaced organic tissues of a patient. A first actuator 24 is mounted to frame member 14 at proximal end 18 thereof and is operatively connected to grasping forceps 20 for controlling the opening and closing of jaws 26 of that forceps, while a second actuator 28 is mounted to frame member 14 at proximal end 18 and is operatively connected to grasping forceps 22 for alternately opening and closing jaws 30 of that grasping forceps. A third actuator 32 including a reciprocatable plunger element or push rod 34 is slidably mounted to frame member 14 and operatively connected to grasping forceps 20 and 22 for increasing the distance between jaws 26 and jaws 30, thereby stretching the clamped organic tissues and facilitating access to the stretched tissues.

As shown in Fig. 2, actuator 32 also includes an articulated linkage 36 comprising a pair of arms 36a and 36b pivotably connected to push rod 34 at the distal end thereof and pivotably connected to shafts 38 and 40 of respective grasping forceps 20 and 22. Shafts 38 and 40 are flexible in a region immediately distal of a distal end of frame member 14, thereby enabling a relative spreading of grasping forceps 20 and 22 from a straightened or mutually parallel insertion configuration of Fig. 1 to a spread use configuration if Fig.

2 upon a distally directed stroke of push rod 34. Push rod 34 is provided at a proximal end with a flange 42 for facilitating manual reciprocation of push rod 34.

Figs. 3A-3C show a distal end portion of clamping device 12 inserted into an abdominal cavity AC of a patient through a laparoscopic trocar sleeve 44 itself traversing an abdominal wall AW of the patient. Fig. 3A illustrates an initial insertion configuration of clamping device 10 wherein push rod 34 is retracted in a proximal direction and grasping jaws 26 and 30 are closed. (This configuration is also used when the clamping device 12 is being withdrawn from abdominal cavity AC upon termination of the laparoscopic tissue spreading operation.)

Upon the insertion of the distal end portion of clamping device 12 into abdomianl cavity AC, push rod 34 may be shifted slightly in the distal direction, if desired, to partially separate jaws 26 and 30 of grasping forceps 20 and 22 (Fig. 3B). Actuators 24 and 28 are then operated to open jaws 26 and 30, whereupon device or instrument 12 is manipulated from outside the patient to engage and hold respective portions of organic tissue, for example, of the colon CN, on opposite sides of a traumatic injury or perforation TP. After a subsequent closure of jaws 36 and 30, push rod 34 is pushed further in the distal direction, as depicted in Fig. 3C, to spread or stretch the tissues of colon CN in the region about traumatic injury or perforation TP.

The stretching of the tissues of colon CN about perforation TP facilitates surgery by providing direct access to the injury. A suturing operation or other surgical treatment may be performed easily on traumatic perforation TP. Upon the closure of perforation TP, the steps illustrated in Figs. 3A-3C are performed in reverse order.

As illustrated in Fig. 4, another surgical clamping device 52 for spreading or stretching clamped organic tissues comprises a frame member 54 having a distal end 56 and a proximal end (not shown). Two clamping or grasping forceps 60 and 62 are movably mounted to frame member 54 at distal end 56 thereof for engaging and holding spaced organic tissues of a patient. Actuators (not shown) are mounted to frame member

54 at the proximal end thereof for controllably opening and closing jaws 66 of forceps 60 and closing jaws 68 of forceps 62. A third actuator includes a rotatable shaft 70 carrying a tapered screw 72 at a distal end. Upon a rotation of shaft 70, screw 72 is pulled into an internally threaded split bushing or nut 74. Nut 74 has a first half 74a attached to a partially flexible shaft 76 of forceps 60, while a second half 74b of nut 74 is fixed to a partially flexible shaft 78 of forceps 62. The entry of screw 72 into nut 74 causes the separation of halves 74a and 74b and consequently of forceps shafts 76 and 78 in opposition to an inherent spring force or a helical tension spring 80 extending between forceps shafts 76 and 78.

As illustrated in Fig. 5, yet another surgical clamping device 82 for spreading or stretching clamped organic tissues comprises a frame member 84 having a distal end 86 and a proximal end (not illustrated). Two clamping or grasping forceps 90 and 92 are movably mounted to frame member 84 at distal end 86 thereof for engaging and holding spaced organic tissues of a patient. Actuators (not shown) are mounted to frame member 84 at the proximal end thereof for controllably opening and closing jaws 94 of forceps 90 and closing jaws 96 of forceps 92. A third actuator includes a slidable shaft 98 carrying a wedge 100 at a distal end. Upon a sliding of shaft 98 in the distal direction, wedge 100 slidingly engages camming elements 102 and 104 which are attached to shafts 106 and 108 of forceps 92 and 94 and forces the shafts apart in opposition to an inherent spring force or a helical tension spring 110 extending between forceps shafts 106 and 108.

Although the invention has been described in terms of particular embodiments and applications, one of ordinary skill in the art, in light of this teaching, can generate additional embodiments and modifications without departing from the spirit of or exceeding the scope of the claimed invention. For example, the clamping action of grasping forceps 20 and 22 may be accomplished by other equivalent engagement and holding devices. In some cases, a hook or paw may perform a clamping or catching operation sufficient for spreading organic tissues as described herein. Alternatively,

the capture and entrainment of internal organic tissues may be implemented by suction nozzles.

Accordingly, it is to be understood that the drawings and descriptions herein are profferred by way of example to facilitate comprehension of the invention and should not be construed to limit the scope thereof.

CLAIMS:

1. A laparoscopic surgical device comprising:

an elongate frame member having a distal end and a proximal end;

stretching means mounted to said frame member at said distal end for engaging and stretching selected internal organic tissues of a patient during a laparoscopic procedure; and

actuator means mounted to said frame member at said proximal end and operatively connected to said stretching means for operating said stretching means to spread the selected internal organic tissues of the patient to faciltate a surgical operation on the selected internal organic tissues.

2. The device defined in claim 1 wherein said stretching means includes:

first engaging means movably mounted to said frame member at said distal end thereof for engaging first organic tissues of the patient, and

second engaging means also movably mounted to said frame member at said distal end thereof for engaging second organic tissues of the patient spaced from the first organic tissues,

said first organic tissues and said second organic tissues being portions of said selected internal organic tissues,

further comprising actuation means, mounted to said frame member and operatively connected to said first engaging means and said second engaging means, for increasing a distance between said first engaging means and said second engaging means upon engagement of said first organic tissues and said second organic tissues by said first engaging means and said second engaging means, respectively.

3. The device defined in claim 2 wherein said first engaging means includes first clamping means for exerting a clamping force on said first organic tissues, said second engaging means including second clamping means for exerting a

clamping force on said second organic tissues, said actuator means including first control means operatively connected to said first clamping means for controlling operation of said first clamping means, said actuator means further including second control means operatively connected to said second clamping means for controlling operation of said second clamping means.

4. The device defined in claim 3 wherein at least one of said first clamping means and said second clamping means includes a pair of jaws.

5. The device defined in claim 2 wherein said first engaging means and said second engaging means are secured to said frame member via respective shafts, said actuation means including an articulated linkage pivotably connected to said shafts, said actuation means further including means for alternately shifting said linkage in a distal direction and a proximal direction.

6. The device defined in claim 2 wherein said actuation means includes an articulated linkage.

7. The device defined in claim 2 wherein said actuation means includes a screw mechanism.

8. A surgical method comprising the steps of:

providing a surgical instrument with an elongate frame having stretching means at a distal end for engaging and stretching organic tissues and actuator means at a proximal end for operating said stretching means;

inserting a distal end portion of said instrument through a laparoscopic trocar sleeve into a patient;

upon insertion of said distal end portion of said instrument through said trocar sleeve, engaging selected organic tissues about an operative site with said stretching means;

upon engagement of said selected organic tissues with said stretching means, operating said actuator means to

stretch said organic tissues; and

upon stretching of said selected organic tissues, performing an operation at said surgical site.

9. The method defined in claim 8 wherein said stretching means includes first means for holding organic tissues and second means for holding organic tissues, said step of engaging including the step of holding said selected organic tissues with said first means and said second means and exerting a force via said surgical instrument to increase a distance between said first means and said second means.

10. The method defined in claim 9 wherein said step of holding includes the step of clamping said selected organic tissues with said first means and said second means.

11. The method defined in claim 8 wherein said stretching means includes a plurality of clamping mechanisms disposed at distal ends of respective flexible shafts connected to said frame, said step of engaging including the step of operating said clamping mechanisms to clamp organic tissues of a patient at spaced points with said clamping mechanisms, said step of operating said actuator means including the step of pressing said shafts apart from one another.

12. The method defined in claim 11 wherein said step of pressing includes the step of operating a screw mechanism.

13. The method defined in claim 11 wherein said step of pressing includes the step of moving an articulated linkage in a distal direction.

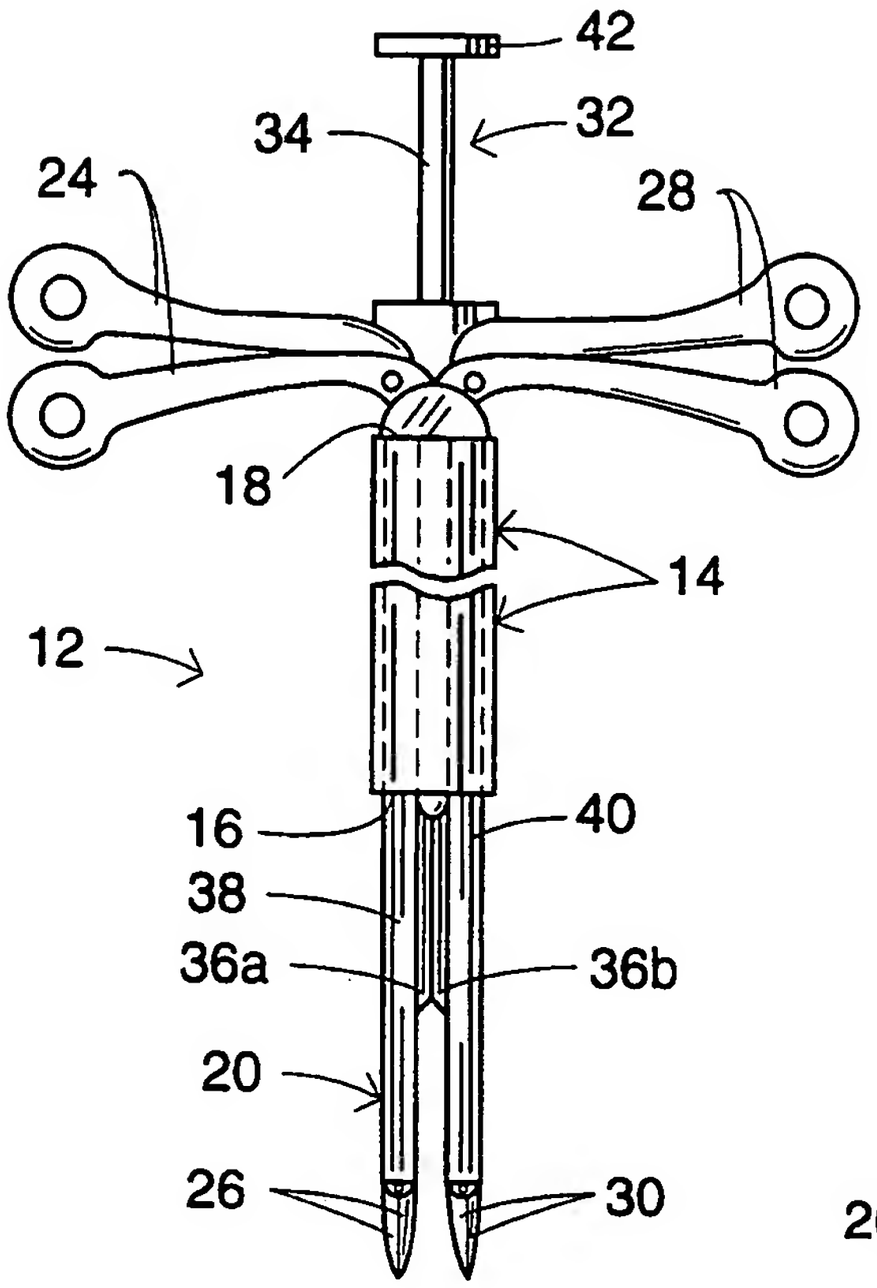

FIG. 1

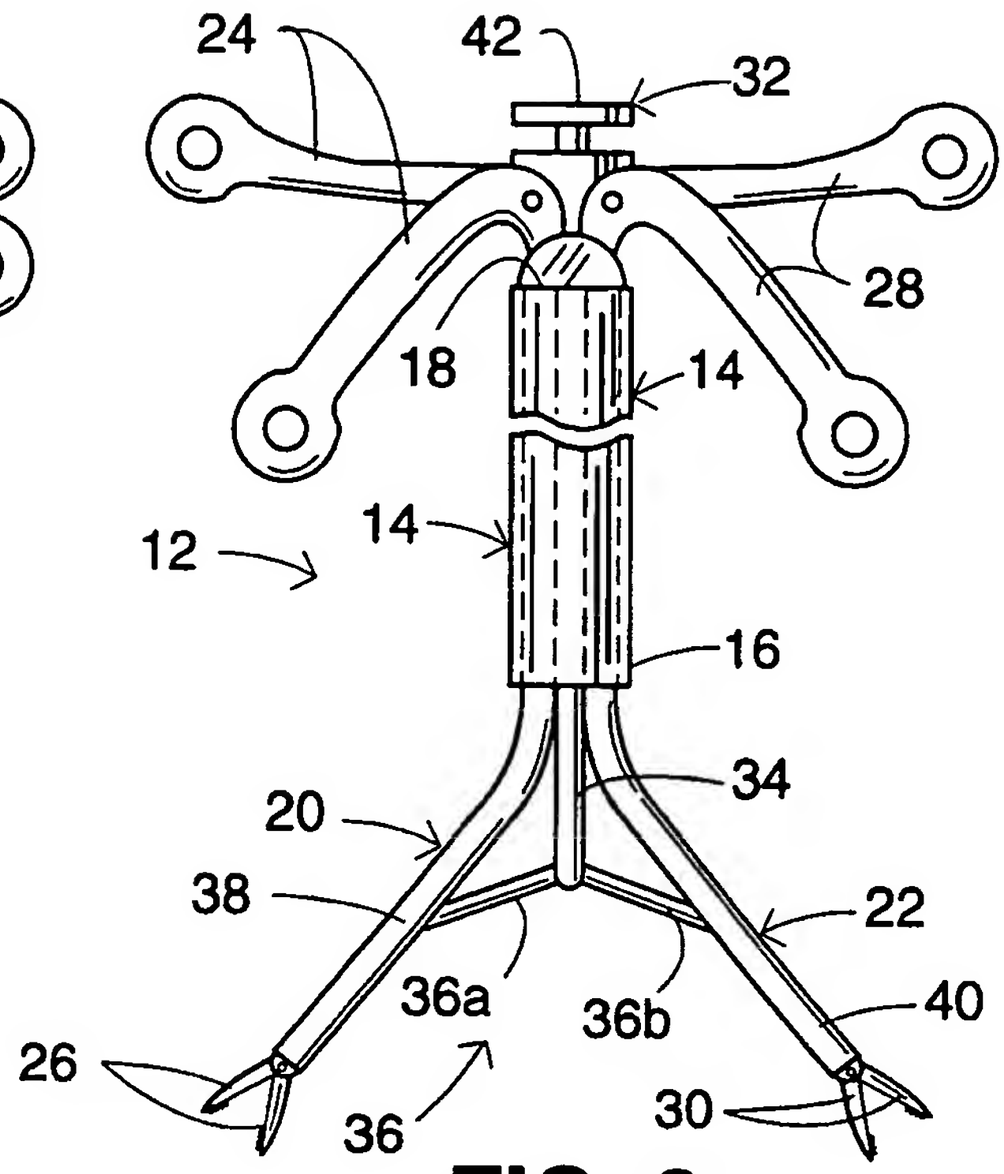

FIG. 2

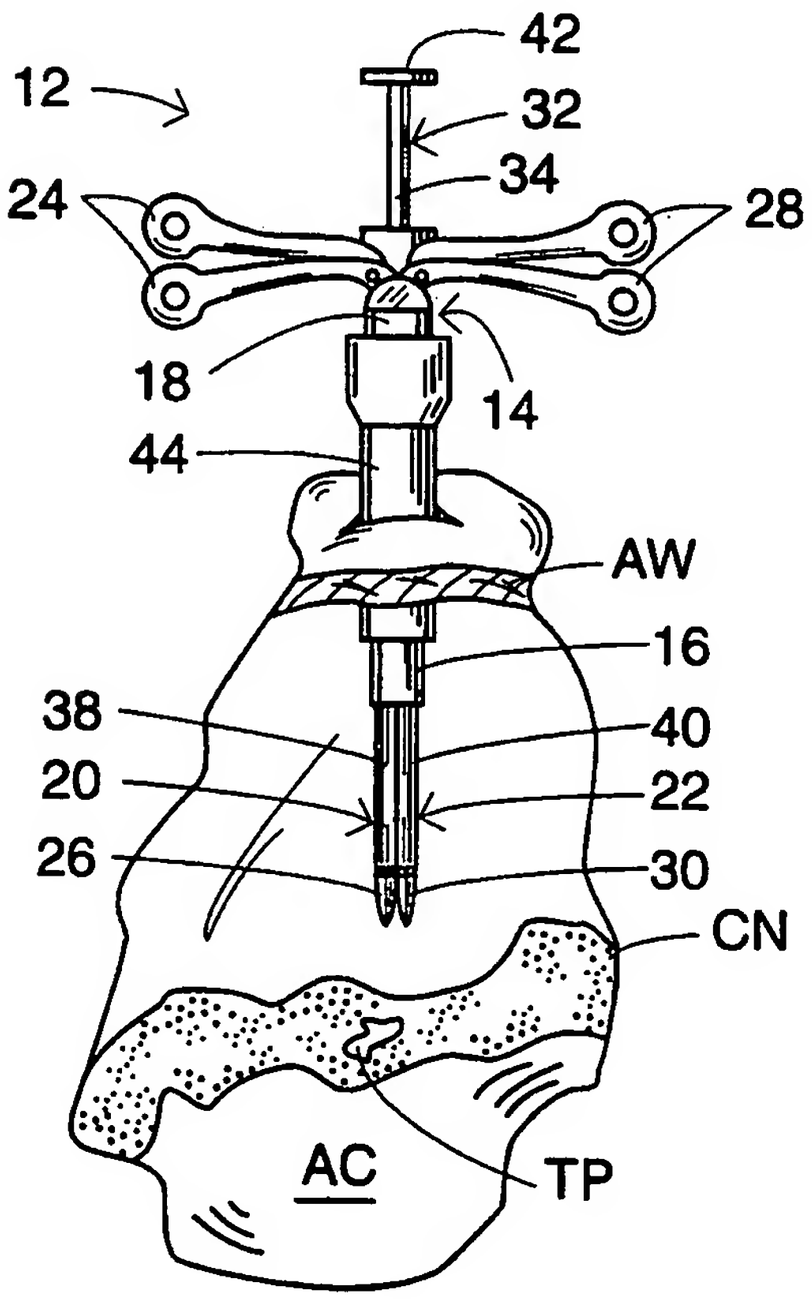

FIG. 3A

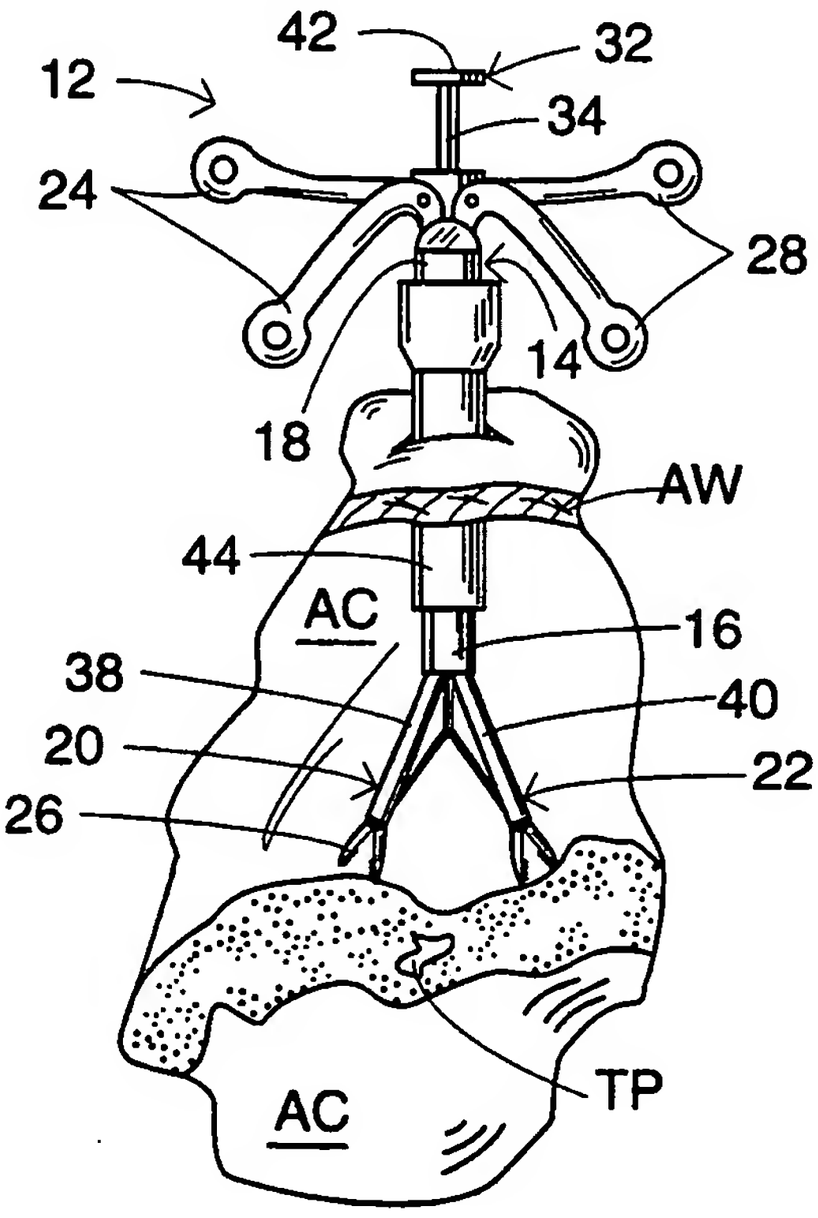

FIG. 3B

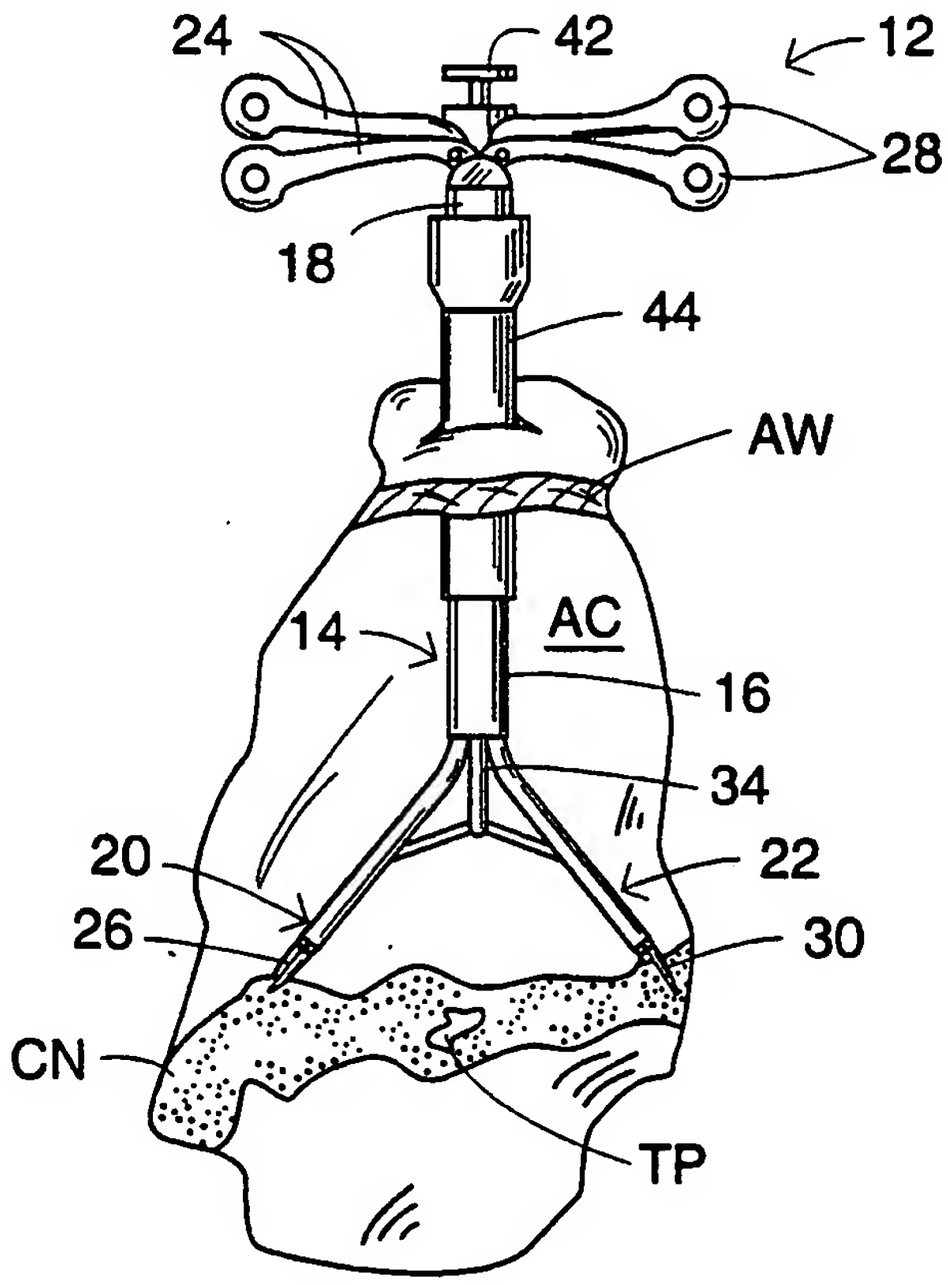

FIG. 3C

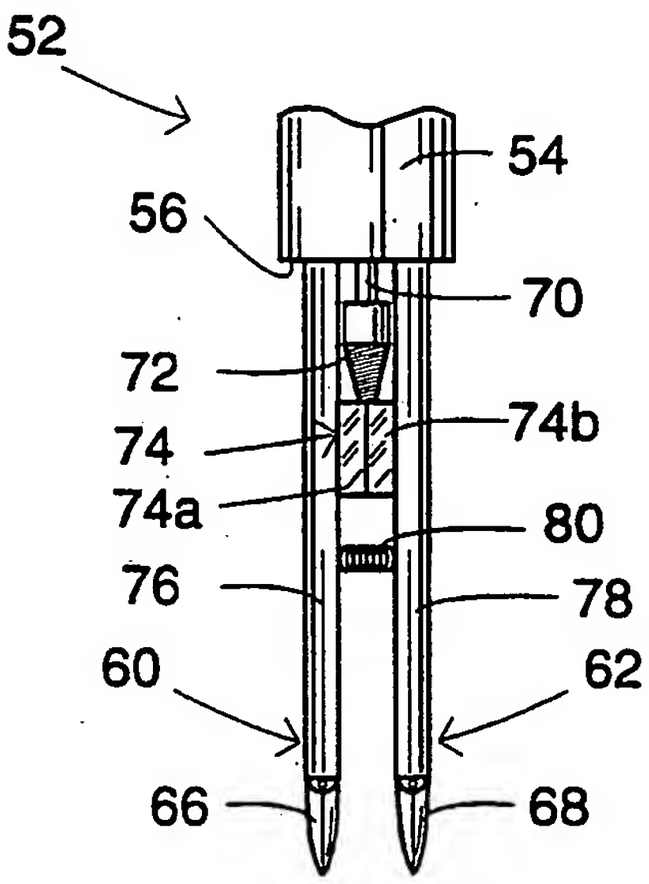

FIG. 4

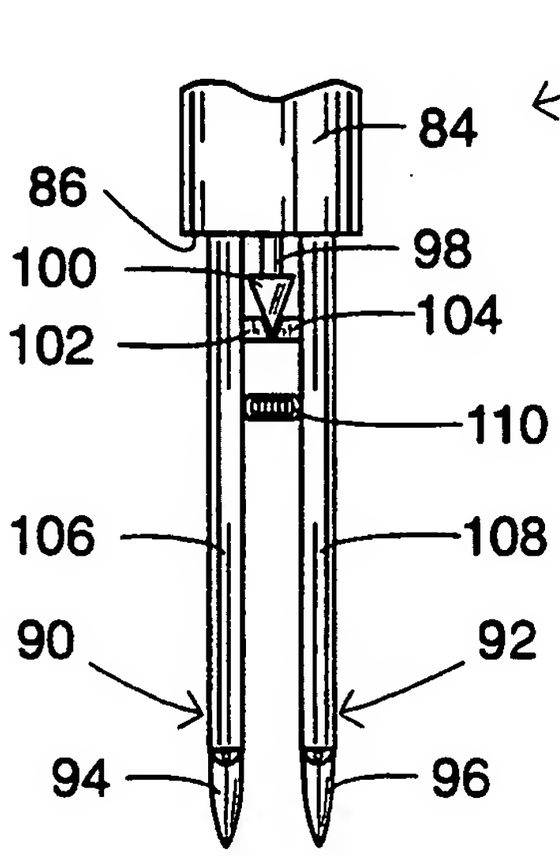

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/06301

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :A61B 17/00
US CL :128/20,898; 606/205,198

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 128/20,898,749; 606/205,198,1,51,52,110,113,127,139-144,151,157,190,205-208;294/89.1,102.1,100,115

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 5,099,827 (Melzer et al) 31 March 1992, see entire document	1
X	US, A 4,700,694 (Shishido) 20 October 1987, see entire document	1
X	US, A, 4,655219 (Petruzzi) 07 April 1987, see entire document	1

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